MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

EEL2046 – ENERGY CONVERSION II
(LE)

5 MARCH 2016
9:00 AM – 11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question Paper consists of three pages including the cover page with 4 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print your answers in the Answer Booklet provided.

Question 1

(a) Name and draw the circuit diagrams of the various types of DC generators. [10 marks]

(b) The magnetization curve of a dc shunt generator driven at 1500 rpm is given in tabular form below.

I_f in A	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Emf in V	5	40	80	108	122	132	138	142

The armature and shunt field resistances are 0.18 Ω and 25 Ω, respectively. The generator speed is 1500 rpm.

(i) What is the no-load terminal voltage of the generator? [3 marks]

(ii) Compute the terminal voltage of the generator when its armature current is 40A. Neglect the effect of armature reaction. [3 marks]

(iii) Determine the load current supplied by the generator if its terminal voltage is 120 V. [4 marks]

(iv) The machine is run as a DC shunt motor with the supply voltage of 120 V and the load current is 40 A. Compute the speed of the motor. [5 marks]

Question 2

(a) How do you reverse the speed of rotation of DC motors? [2 marks]

(b) Explain the Kapp-Hopkinson test used to predict the efficiency of a DC machine. [11 marks]

(c) Design an automatic starter circuit for a 250-V, 400-A shunt motor having an armature resistance of 0.05 Ω. The starter should limit the motor starting current to twice its rated value and the resistance stage is cut when the current falls to the rated value.

(i) How many stages of starting resistance are needed and what is the resistance of each step? [6 marks]

(ii) At what voltage should each stage of the starting resistance be cut out? [6 marks]

Continued...

Question 3

(a) With brief explanations rank the single-phase induction motors in terms of their starting and running characteristics. [10 marks]

(b) A 230-V, 4-pole, 50 Hz single-phase induction motor has the following impedances.

$R_1 = R_2 = 8\ \Omega$, $X_1 = X_2 = 12\ \Omega$ and $X_m = 200\ \Omega$.

The core loss is 30 W, and the friction and windage losses are 20 W. The motor operates at rated voltage and rated frequency, with its starting winding open, and the motor's slip is 4%. Determine the following:

(i) Motor speed [1 mark]
(ii) Input current [4 marks]
(iii) Input power [1 mark]
(iv) Air-gap power [3 marks]
(v) Output power [2 marks]
(vi) Efficiency of the motor [1 mark]
(vii) Output torque [1 mark]
(viii) The ratio of the amplitude of the forward-rotat5ing flus to the backward-rotating flux. [2 marks]

Question 4

(a) State the special requirements of the magnetic materials required for permanent magnet dc (PMDC) machines. [2 marks]

(b) Discuss the advantages and disadvantages of PMDC machines compared to conventional DC shunt motors? [8 marks]

(c) A 20-V, PMDC motor develops a torque of 1.0 Nm at the rated voltage. The magnetic flux in the motor is 2 mWb. The armature resistance is 0.93 Ω, and the motor constant is 95. Calculate the operating speed and the torque developed in blocked rotor condition. [5 marks]

(d) With a simple sketch explain the constructional details and working principle of a Printed circuit board (or disk armature) motor. [7 marks]

(e) A three-phase moving-rail Linear Induction Motor has three poles and a pole pitch of 0.24 m. The motor is operated from a 50 Hz system. Determine the rail speed in km/h if the slip of the motor is 16.7% [3 marks]

End of Paper